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INCREASING WASTEWATER TREATMENT EFFICIENCY USING HYDROBIONTS

D. B. Bozorova
Bukhara State Medical Institute

Abstract
This article is focused on wastewater treatment using hydrobionts and was conducted in the Bukhara water supply. As a result, in order to ensure the activity of microorganisms in the treatment plant and increase the efficiency of high purification, it was achieved to ensure that the oxygen content in the aeration tank was not lower than 4.6 mg/l and the IL index was not lower than 150 mg/l. It was recommended to use the treated wastewater for irrigation of technical crops and ornamental plants.

Keywords: Wastewater, hydrobionts, treatment, seriobacteria, Infusoria.

Introduction

Today, the results of global climate change are having a dramatic impact on the climate of Uzbekistan. In particular, the drying up of the Aral Sea in the span of a generation (over 60 years) and the emergence of the Aral Desert on its territory of 5 million hectares are creating complex socio-economic and ecological problems in the oasis. Such complex processes are reflected in the ecosystems of the Bukhara region. High temperatures, drought, desertification are leading to a shortage of drinking and irrigation water from year to year. The treatment and reuse of generated technical and domestic wastewater are factors that mitigate the problems that have arisen. For this reason, the Bukhara city wastewater treatment plant was selected as an object for conducting scientific and practical work, monitoring, sampling, conducting chemical and biological analyzes, and conducting test experiments.

The Bukhara City "Wastewater Treatment Plant" belonging to the "Bukhara Water Supply" Limited Liability Company was commissioned in 1972 and the initial treatment was mechanical. The facility consisted of a building of iron barriers (rings), sand traps, primary clarifiers and biological artificial ponds (biopruds), through which wastewater was treated and discharged into the Sakovich ditch. In 1984, the design capacity was 100 thousand / m, additional primary clarifiers, aerotanks, an air pumping station, secondary clarifiers, sludge collection areas, and chlorination buildings were built and commissioned in 1985. However, the volume of wastewater entering the treatment plant reached 45-50 thousand / m due to the wastewater of the Bukhara Textile Combine. The composition of the wastewater was strongly alkaline, acidic, microorganisms died in the aeration tank and the IL index was 50-60 mg / l, and the overall efficiency of the facility was 30-40%. In accordance with the Resolution of the President of the Republic of Uzbekistan No. PQ-1216 dated October 29, 2009 "On measures to implement the project "Reconstruction of treatment facilities and sewage systems in the cities of Bukhara and Samarkand", in 2014-2016, the 1st phase of reconstruction work was carried out at the facility. The building of the chanbaraklar, sand traps, primary clarifiers, aeration tanks, secondary clarifiers, were reconstructed, and 6 air pumping stations were re-equipped with modern equipment.

Water and hydrobiological samples were taken from the treatment plant seasonally and chemical analyses and tests were conducted in the laboratory.

The treatment plant receives 38-40 thousand m3 of wastewater generated per day in the cities of Bukhara and Kogan. Its seasonal volume and chemical composition vary. The wastewater received at the treatment plant is initially cleaned of large mechanical impurities in a circular structure, and anaerobic bacteria, helminth eggs, sand, soil and metal particles contained in the wastewater are retained by up to 65-70% using sand trap devices.[1,2,4]

1- Table Chemical composition of wastewater received at the treatment plant

Ingredients	Spring		summer		autoum		winter	
	Mg/l	Kg/m	Mg/l	Kg/m	Mg/l	Kg/m	Mg/l	Kg/m
Ammonium ion	48,4	77,8	52,5	84,4	45,3	72,08	40,07	65,4
Nitrites	2,84	4,5	2,86	4,6	2,58	4,1	2,38	3,8
Nitrates	0,8	1,3	0,5	0,8	1,2	1,9	1,5	2,4
Dry residue	1350	249,2	1640	263,7	1750	286,2	1790	287,8
Sulfates	480,3	772,6	560,6	901,6	612,4	984,9	668,5	1075,1
Chlorides	292,7	470,7	298,8	479,5	305,4	491,4	306,8	403,4
Oxygen	Yo'q	_	Yo'q	_	Yo'q	_	Yo'q	_
pH	6,2	_	6,6	_	5,7	_	6,4	_
Phosphates	3,5	5,6	4,8	7,7	3,8	6,1	2,9	4,6
Suspended solids	220	353,8	242	389,2	252	361,8	220	353,8
Water temperature C	17-20		20-24		17-20		10-14	

Note: The treatment plant receives an average of 1608 m3 of wastewater per hour. Due to the lack of dissolved oxygen in the wastewater received by the Bukhara City Treatment Plant, organic matter is decomposed with the participation of anaerobic bacteria. As a result, the amount of nitrite and ammonium salts in the wastewater increases. With the participation of anaerobic bacteria, organic matter in the wastewater is decomposed to nitrites during the denitrification process, and toxic gases such as ammonia and hydrogen sulfide are formed.

The processes of wastewater treatment from suspended solids continue in the primary clarifier. The primary clarifiers consist of 4 radial clarifiers with a capacity of 25 thousand m, 2 of which are working and 2 are in reserve. The primary clarifiers consist of settling the suspended impurities in the wastewater for 2 hours in accordance with the wastewater treatment time (regulation). In the facility, wastewater is cleaned of 65-70% of suspended solids under the influence of centrifugal force during the rotation of special buckets and falls into the aerator, into which air is supplied under strong pressure. The amount of dissolved oxygen in the water is brought to 4-6 mg. As a result, biodiversity (bacteria, soda animals, amoeba, crayfish, infusoria) develops in the water. [3,6]

While the average ammonium content in wastewater was 77.8 kg/m3 per hour in spring, this indicator increased to 84.8 kg/m3 in summer. Similarly, nitrites in wastewater also have a seasonal character, with their content in spring being 4.5 kg/m3, in summer 4.5 kg/m3, in autumn an average of 4.1 kg/m3 and in winter 1.3 kg/m3, while nitrates range from 3.8 to 2.3 kg/m3 from spring to winter. The amount of phosphates was recorded in the range of 4.6-7.7 kg/m3. The maximum indicator of the amount of suspended solids in wastewater is 389.2 kg/m3 (in summer) and the minimum is 353.8 kg/m3 (in winter). The composition and amount of mineral salts was recorded at 249.2-287.8 kg/m.

In order for the ammonium salts and nitrogen nitrites contained in the wastewater to be completely decomposed into nitrate ions in the aeration tank, the active clay index in the aeration tank should be 200-250mg/l and the dissolved oxygen content in the water should be 4-6 mg/l, and its active participation in the purification process should achieve the complete decomposition of organic substances contained in the wastewater. The second important factor is the ratio of air pumped into the aeration tank, which is 4-4 m to 1 m of air. The duration of complete purification of wastewater in the aeration tank is 10-12 hours.

As a result of the experiment, it was noted that the organic matter content of wastewater in the aeration tank is primarily determined by the activity and quantity of bacteria. According to A.G. Rodina (1965), the decomposition of organic pollutants in wastewater by bacteria occurs in a logarithmic graphic phase, and in the remaining stages, the bacteria pass into the zoogel (turbid) phase. It is possible to observe the diversity of the composition of microorganisms during the decomposition period with the participation of aerobic bacteria participating in the nitrification process of wastewater. Microorganisms are based on the use of organic matter in wastewater as food for their vital activity. With the acceleration of the nitrification process in wastewater, that is, with the increase in the amount of dissolved oxygen in water (4-6 mg / l), ammonium salts, nitrogen dioxide into nitrates, representatives of the kolvratka began to dominate in the active composition of the active layer, replacing sedentary and free-swimming infusoria. Among these, several species of Brachionus, Microcolidia, Asplanchia, and Keratella were found to be among the dominant species, as reflected in the analyses and tests conducted.

The wastewater index refers to the amount of organisms in the sludge. Specific indicators of the level of effectiveness of the active sludge were determined through experiments. The level of effectiveness was determined by conducting rapid experimental tests using seriodaphnia. Such rapid experiments are carried out in collaboration with the specialists of the analytical laboratory of the Bukhara regional Department of Ecology and Environmental Protection on samples taken from the treatment plant.

The following microorganisms were recorded as dominant species in the active sludge:

Among the amoebas - Pelomyxa palustris.

Infusoria - Colpidium Cotruit, Colpidium Colpoda, Euplotes charon, Chilodou Cuculatus, Opescularia coarstata, Poramaeccium caudatum, Vorticella microstoma, V.convularia, Philodnia rosiola, calidina vorax, acpidiska species.

Rotwrants - Keratela longispina, Notholca longispina, Keratela quadrata, Leucane lunaris, Rotaria rototoria, Filin asp, Asplanchna vitullus, Braxionus sp and others.

Colorless ciliates - active in wastewater with high load conditions and a high content of organic substances and a dissolved oxygen content in water below 2 mg / l, and their size was recorded at 10 µm.
The dominance of stationary and free-floating infusoria in the composition of well-developed active filaria is indicated by a high filaria index of 250 mg / l. Filamentous bacteria - Cladothrix and Sphaerotilus were observed to participate in the purification of wastewater, mainly contaminated with hydrocarbons, and in the presence of an alkaline or acidic environment in the composition of textile industry wastewater. Even these bacteria, depending on the type of nutrition, Cladothrix synthesizes nitrogen from any compound, and Sphaerotilus grows only at the expense of organic nitrogen and forms long filaments. They develop well under aerobic conditions and, by pore-forming the active filaria, form foamy swellings of the filaria mass. Filamentous seriobacteria - specialize in the purification of hydrogen sulfide in industrial wastewater and fermented proteins in domestic wastewater. The oxidation of hydrogen sulfide occurs in two phases. Initially, hydrogen sulfide is oxidized to sulfur. In the absence of oxygen (anaerobic) conditions, the oxidation process of hydrogen sulfide stops.
If the wastewater is acidic, the fungus Fusdarium aquadectum develops, adhering to the walls of the aeration tank. When the biological absorption of oxygen is high (KBS-5) in the active sludge, the bacterial species Verticella appears when the dissolved oxygen content is below 2 mg/l. During the regeneration period of the active sludge, Verticella (infusoria) is formed in the sludge. Under unfavorable conditions, when the dissolved oxygen content in the wastewater is below the norm (2-3 mg/l), the water environment is acidic (pH6-5), and in the presence of highly toxic substances, the infusoria in the active sludge form cysts. In the active sludge, the infusoria representatives Aspidisca coccidae, A. species are constantly found, especially dominant in the summer, accelerating the nitrification process in the wastewater.
The following representatives of the Kolovrats, such as Lecane, Brachionus, Micropoludia, Caratella, Asplanhina, can develop well when oxygen is high (4-6 mg / l) and there is enough food for the active cilia. The satisfactory functioning of the aerobatic cilia depends on its diversity, which is one of the main factors in the dominance of certain species. The activity and mobility of the dominant species, as well as the color of the active cilia, are of great importance. The appearance of actively moving (living) cilia is brown. [5,7,9]
A period of starvation of the active cilia is also noted in the aerobatic cilia. During this period, the color of the active cilia becomes whitish-green. This situation occurs when the wastewater contains a low amount of organic matter, and some of the infusoria in the cilia die, and some turn into cysts. Representatives of the Kolovrats later form cysts and sink to the bottom of the aerobatic cilia. The active substance discolors and forms a precipitate that gives the surface color. It was noted that the efficiency of wastewater treatment in aeration tanks depends on three important indicators.
*Wastewater aeration period;
*Activated sludge concentration and sludge regeneration;
*Aeration tank air consumption
The efficiency of purification using microorganisms in the aeration tank of the Bukhara City Wastewater Treatment Plant is determined by the dose of activated sludge above 5 j / l. The index of activated sludge was recorded in the range of 100-250 mg / l. A change in this indicator has a

negative or positive effect on wastewater purification. Therefore, it leads to a decrease or increase in the transparency of the purified water. If the transparency indicator is 3-4 cm and higher, other general ecological sanitary indicators provide a high level of purification.

Bioponds consist of 3-4 stages. In the basins, bacteria use oxygen produced during photosynthesis to oxidize pollutants. Higher aquatic plants, in turn, consume CO_2 gas, nitrogen nitrates, formed during the biochemical decomposition of organic matter, and produce a large amount of phytomass. For example, in experiments conducted in one of the bioponds of the Bukhara City Treatment Plant (Yuldoshov 2022), it was determined that 150 g of small lyme (lemna minor) plants planted on 1 m2 of surface area could produce 625 g of biomass in 8 days.

According to the data presented in Table 3, seasonal purification efficiency of the treatment plant from biogenic substances, up to 95-96% of ammonium salts were removed in the spring-summer season, and up to 91% in the autumn-winter season. Similar results were achieved for nitrate removal, ranging from 87.4% to 93%, and phosphate removal, ranging from 93-97%.

The fully treated wastewater was passed through bioponds, neutralized, and tested in several stages for 48 hours using the zooplankton representative

Daphnia longispina Mull. In the experiment, it was noted that 85-90% of thetest experiments conducted using 5-7-day-old nauplii (larvae) of Daphnia survived.

Conclusion

1. In order to ensure the activity of microorganisms in the treatment plant and increase the efficiency of high purification, the oxygen content in the aeration tank should not be lower than 4.6 mg/l and the IL index should not be lower than 150 mg/l.
2. It was recommended to use treated wastewater for irrigation of technical crops and ornamental plants.
3. For the first time, more than 120 species of microorganisms were identified in the treatment plant of "Bukhara Water Supply" LLC, and 15 of them are dominant indicator species.

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